Maine Forestry Best Management Practices
Use and Effectiveness
2001-2003

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Executive Summary

Best Management Practices (BMPs) are a broad range of recommended techniques for minimizing water quality impacts during timber harvesting.[1] Despite a long history of development, training, and implementation, little comprehensive data on BMP use and effectiveness existed prior to the Maine Forest Service (MFS) report published in 2001.

The MFS and FORAT (Forest Advisory Team, a broad stakeholder group) developed a methodology for monitoring BMPs on timber harvest sites in 1999, based in part on the 1996 Briggs report[2]. MFS instituted random, statewide monitoring of BMPs on timber harvesting operations in March of 2000. The objectives of this ongoing effort are to assess the use and effectiveness of BMPs in Maine and evaluate trends. The goals of this effort do not include assessing compliance with or enforcement of laws and rules.

This report presents findings from the second reporting period, representing 20 months of data collection from June 2001 to November 2003. MFS continues this monitoring effort as a part of regular field activities and expects to generate subsequent reports.

For this reporting period, key findings regarding the use and effectiveness of BMPs are:

- **BMPs either were used appropriately or with a "good attempt" on 75% of harvest sites with water bodies present.** This represents a roughly 12% improvement over the prior reporting period.
- **BMPs use was effective in avoiding soil deposition into surface waters on 82% of harvest sites with water bodies present,** a 22% improvement over the prior reporting period**.**
- **Appropriate use of BMPs minimizes water quality impacts**. Harvest sites demonstrating appropriate BMP use always prevented major soil movement and sedimentation of water bodies.
- **Inadequate BMP use can lead to soil movement and discharge to water bodies.** Minimal or no application of BMPs always resulted in major soil movement and soil delivery to water bodies.
- **Forty-one percent of harvest sites examined do not have surface water bodies in the immediate harvest area.** Harvest planning to avoid water bodies is a valid BMP.

This study also developed additional information on the context in which BMPs are applied:

- **BMP use and effectiveness were rated somewhat lower for investor landowners than for other landowner classes.** MFS and others may need to direct additional educational efforts toward this landowner class.
- **BMP use and effectiveness on harvests with licensed foresters involved do not appear to differ substantially from other harvests.** However, MFS did not closely examine the degree of actual forester involvement in harvest planning and supervision.

[1] Although various state and local statutes and rules require some techniques, BMPs were designed as voluntary measures.

[2] Briggs, R., Kimball, A., Cormier, J. 1996. Assessing compliance with BMPs on Harvested Harvest sites in Maine: Final Report. University of Maine, Cooperative Forestry Research Unit Research Bulletin 11. 35 pp.

Introduction and Background

The 118th Maine Legislature directed the Maine Forest Service (MFS) to evaluate the progress made by timber harvesting operations in implementing forestry Best Management Practices (BMPs) to protect water quality (PL 1997, Chapter 648). This legislative directive responded in part to the findings of the Briggs study of 1996[3], a joint effort by MFS, university researchers, and the Forestry Advisory Team (FORAT). FORAT is a broad-based advisory group of stakeholders whose mission is to advise MFS and the Department of Environmental Protection on water quality issues related to forest management.

The Briggs study reported on BMP use and effectiveness by examining recommended BMPs in detail on 120 harvest sites. The study concluded that applicable BMPs work well when implemented, but that use of individual BMPs varied from very low to very high. There was broad recognition of the need to provide regular, statewide information on trends in BMP use and effectiveness. Such information would help MFS to focus educational efforts for foresters, loggers, and landowners in BMP use.

With FORAT's assistance, MFS developed a monitoring protocol to conduct regular, statewide monitoring of BMP use and effectiveness on timber harvesting operations. Monitoring, as opposed to in-depth research, allows the capture of a broad snapshot over time of BMP implementation on timber harvests statewide. Trends in rates of BMP use and effectiveness are of key interest.

MFS field-tested a monitoring protocol and data sheet in 1999, made additional modifications upon review by FORAT, and trained MFS field staff in the use of the sheet. The methodology rates BMP use and BMP effectiveness independently. **BMP use** relates to implementing specific principles on a harvest area. **BMP effectiveness** assesses the impact of harvest activities on water quality and is rated in terms of soil movement and soil delivery to surface waters.

Harvest sites are selected randomly in ten districts statewide, based on Forest Operations Notifications (FON) submitted to MFS. MFS requests landowner permission to conduct the field work, which does not assess compliance with state statutes, regulations, or local ordinances. [4]

Monthly monitoring of randomly selected field harvest sites by MFS Field Foresters and Forest Rangers began in March 2000. This report presents the second compilation of data under this monitoring effort. It is based on analysis of data collected from June 2001 to November 2003. Data collection by MFS personnel focuses on areas of recent harvest activity and presence of surface water.

[3] Briggs, R., Kimball, A., Cormier, J. 1996. Assessing compliance with BMPs on Harvested Harvest sites in Maine: Final Report. University of Maine, Cooperative Forestry Research Unit Research Bulletin 11. 35 pp.

[4] Readers interested in detailed information on the methodology and/or data sheet are encouraged to contact MFS.

A quality control team composed of FORAT volunteers reviewed implementation of the program by visiting sites in all ten districts. MFS considered and, where appropriate, incorporated modifications of the monitoring methodology, based in part on the experience of the quality control team. The team played an important role in assuring consistent application of the monitoring protocol.

Field monitoring, analysis, and reporting are performed with existing staff resources, as no new resources were allocated for this program. Field time is coordinated with other MFS activities as much as possible. Absent significant changes in staffing levels or bureau priorities, MFS expects to continue BMP monitoring indefinitely and to report periodically on the most recent data. Due to a lack of resources, it is unlikely that reports will be generated annually.

Results

Presence of water bodies

MFS selected 491 sample harvest sites at random from the FON database. Preliminary field investigation determined that 39 sites were unsuitable for the study.

Water bodies occurred on 64% (288) of the 452 harvest sites visited. First order and second order streams are the most common types of surface water found, occurring on 32% and 30% of the harvest sites, respectively. Third order streams, intermittent streams, lakes, and non-forested wetlands were observed less frequently.

On the remaining 36% of the sample, no water bodies were found within or immediately adjacent to the harvest area or the harvest access road associated with the harvest. The study did not directly assess whether water bodies were explicitly avoided by harvest planning, layout, or site selection.

Overall BMP Use and Effectiveness

For each of the 288 harvest sites with surface waters present, BMP use and BMP effectiveness were examined within five broad categories of harvest-related activity:

- skid trail channeling of water;
- temporary (in-woods) stream crossings;
- logging filter strips;
- haul road stream crossings; and,
- haul road filter strips and drainage systems.

Table 1. Overall BMP Use and Effectiveness on 288 harvest sites		
BMP Use	**n**	%
BMPs used appropriately	150	52%
Good attempt, needs improvement	66	23%
Minimal attempt	47	16%
BMPs used after the fact to correct an existing problem	2	1%
BMPs not applied*	23	8%
TOTALS	288	100%
BMP Effectiveness	**n**	%
Effective - negligible soil movement	184	64%
Somewhat Effective - soil movement, soil does not reach water body	52	18%
Ineffective - minor soil movement, minimal soil delivered to water body	48	17%
Ineffective - major soil movement, soil delivered to water body	4	1%
TOTALS	288	100%
*Where recommended or applicable		

Figure 1. BMP Use on 288 harvest sites

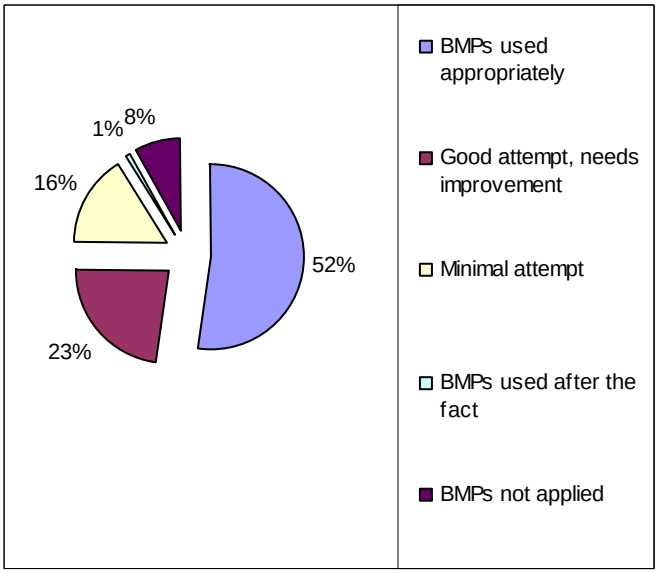
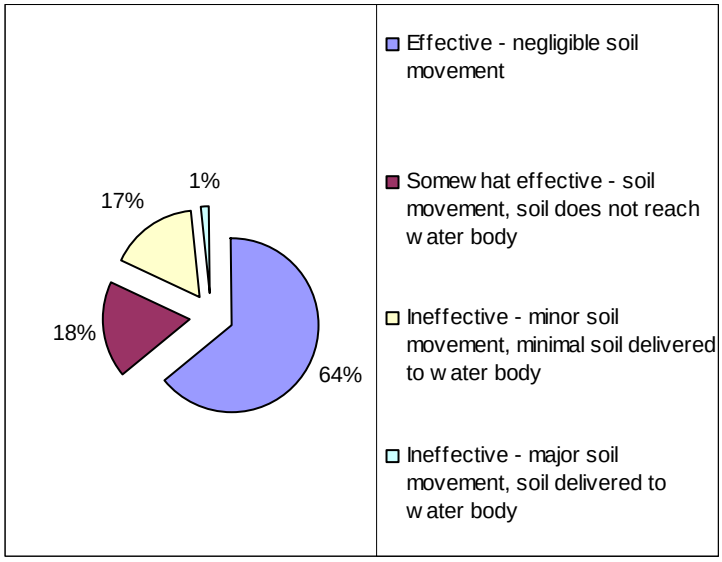


Figure 2. BMP effectiveness on 288 harvest sites



- BMPs were used appropriately or with good attempt on 75% of the sample. This represents a 12% improvement over the prior reporting period. BMPs were fully effective (no evidence of major soil movement and deposition) on 150 sites where BMPs were used appropriately.
- BMPs were used with a minimal attempt, or not used at all, on 24% of the sample.

- BMPs were effective in preventing soil deposition to surface waters on 82% of the sample sites, a 22% improvement over the previous reporting period.
- All four of the harvest sites that had at least one instance of "ineffective, major soil movement, soil delivered to water body" had multiple sources of sedimentation. These harvest sites had a BMP Use rating of "not applied."

These results suggest that BMPs are effective in protecting water quality when used appropriately, while inadequate or ineffective BMP use negatively affects water quality.

Harvesting at appropriate time of year

Harvests took place under winter conditions (snow-covered or frozen ground) on 45% of 452 harvests in the sample. Harvest sites with surface waters were more likely to be harvested under winter conditions (51% of the 288 sites with surface waters) than harvests with no surfaces waters present (36% of the 164 sites with no surface waters).

BMPs were used more frequently and more successfully on sites harvested in winter conditions than on harvests conducted during other seasons (Table 2). BMPs were used appropriately or with good attempt on 78% of the harvests conducted under winter conditions, compared to 69% of harvest during other seasons. BMPs were effective or somewhat effective on 84% of the winter harvests, compared to 73% of the harvests in other seasons.

Table 2. BMP use and effectiveness in winter harvests and non-winter harvests

	Winter harvest (146 sites)		Non-winter harvest (142 sites)	
BMP Use	**n**	**%**	**n**	**%**
BMPs used appropriately	83	57%	62	44%
Good attempt, needs improvement	31	21%	35	25%
Minimal attempt	24	16%	25	17%
BMPs used after the fact to correct an existing problem	1	1%	1	1%
BMPs not applied	7	5%	19	13%
BMP Effectiveness				
Effective - negligible soil movement	97	66%	80	56%
Somewhat effective - soil movement, soil does not reach water body	26	18%	24	17%
Ineffective - minor soil movement, minimal soil delivered to water body	19	13%	34	24%
Ineffective - major soil movement, soil delivered to water body	4	3%	4	3%

BMP Use and Effectiveness by BMP Category

The use and effectiveness of BMPs on 288 harvest sites with a water body were rated for five categories of BMPs as outlined below:

Logging BMPs

- skid trail channeling of water;
- temporary (in-woods) stream crossings
- filter strips (in harvested areas);

Haul Road BMPs

- haul road stream crossings; and,
- haul road filter strips and drainage systems.

Table 3 summarizes the use and effectiveness of BMPs at five general locations on a harvest site.

Table 3. BMP Use and BMP Effectiveness, by BMP Category

	Skid trail channeling of water		Temporary (logging) Stream Crossings		Logging Filter Strips		Haul Road Stream Crossings		Haul Road Filter Strips & Drainage Systems	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
BMP Use	(244 harvest sites)		(48 harvest sites)		(112 harvest sites)		(56 harvest sites)		(137 harvest sites)	
BMPs used appropriately	166	68%	26	54%	85	76%	32	57%	60	44%
Good attempt, needs improvement	45	18%	7	15%	15	13%	12	21%	41	30%
Minimal attempt	24	10%	8	17%	5	5%	8	14%	23	17%
BMPs used after the fact to correct an existing problem	1	0%	1	2%	2	2%	2	3%	2	2%
BMPs not applied	8	3%	6	13%	5	5%	2	3%	11	8%
	244		48		112		56		137	
BMP Effectiveness	(244 harvest sites)		(48 harvest sites)		(112 harvest sites)		(56 harvest sites)		(137 harvest sites)	
Effective - negligible soil movement	185	76%	31	65%	94	84%	35	62%	70	51%
Somewhat effective - soil movement, soil does not reach water body	39	16%	5	10%	11	10%	5	9%	39	28%
Ineffective - minor soil movement, minimal soil delivered to water body	20	8%	11	23%	6	5%	14	25%	24	18%
Ineffective - major soil movement, soil delivered to water body	0	0%	1	2%	1	1%	2	3%	4	3%
	244		48		112		56		137	

General observations that can be drawn from Table 3 include:

- Logging BMPs (skid trail channeling of water, temporary stream crossings, and logging filter strips) are applied more often than Haul Road BMPs.
- Minor soil movement with minimal sediment delivery occurred across all five BMPs, with the highest incidence of sediment delivery occurring at temporary stream crossings (23%) and haul road stream crossings (25%).
- Logging filter strips had both the highest rate of use and the fewest occurrences of sediment delivery to surface water.

Ownership distribution

Figure 3 illustrates the distribution of harvest sites with water bodies by landowner type.

Figure 3. Distribution of 288 harvest sites by landowner type

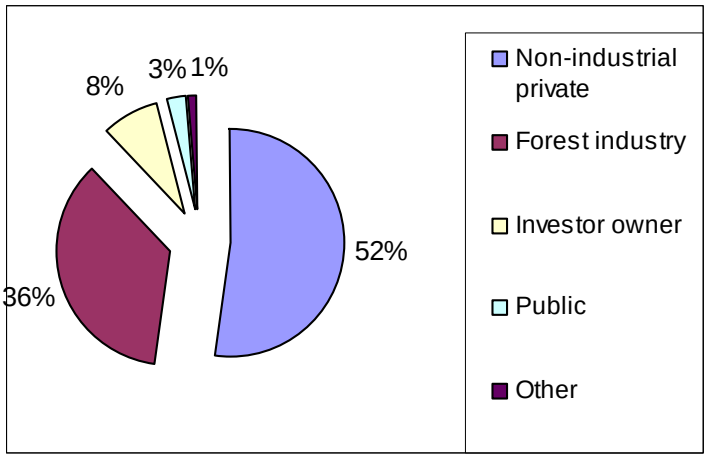


Table 4 and Figures 4 and 5 summarize BMP use and effectiveness by landowner type.

Table 4. BMP Use and Effectiveness by Landowner Type

	Non-industrial private (167 harvest sites)		Forest Industry (88 harvest sites)		Investor (26 harvest sites)		Public (8 harvest sites)		Other (2 harvest sites)	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
BMP Use										
BMPs used appropriately	82	49%	44	50%	12	46%	5	63%	2	100%
Good attempt, needs improvement	35	21%	27	31%	5	19%	2	25%	0	0%
Minimal attempt	30	18%	12	14%	7	27%	0	0%	0	0%
BMPs used after-the-fact to correct existing problem	1	1%	1	1%	0	0%	0	0%	0	0%
BMPs not applied	19	11%	4	5%	2	8%	1	13%	0	0%
	167		88		26		8		2	
BMP Effectiveness										
Effective - negligible soil movement	107	64%	53	60%	12	46%	6	75%	2	100%
Somewhat effective - soil movement, soil does not reach water body	27	16%	19	22%	6	23%	1	13%	0	0%
Ineffective - minor soil movement, minimal soil delivered to water	31	18%	14	16%	8	31%	0	0%	0	0%
Ineffective - major soil movement, soil delivered to water body	2	1%	2	2.%	0	0%	1	13%	0	0%

	167		88		26		8		2	

Figure 4. BMP Use by Landowner Type

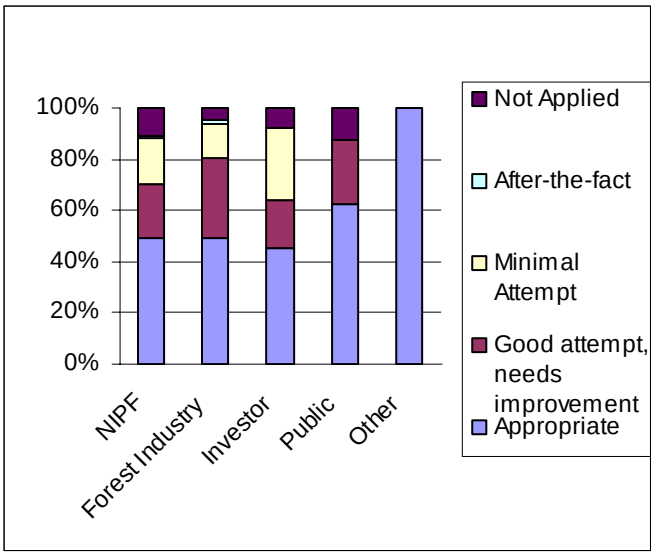
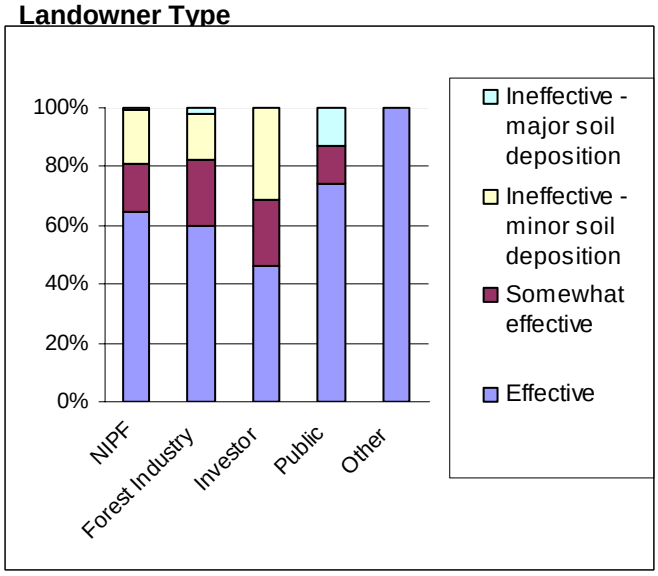


Figure 5. BMP Effectiveness by Landowner Type



- Forest industry landowners and public landowners demonstrated appropriate or a good attempt at BMP implementation to a greater extent than non-industrial private landowners and investor owners (Table 4 and Figure 4).
- The highest rates of ineffective BMP use (with soil deposition in surface waters) were found on investor landowners: nearly one-third of the investor-owned sites had soil delivered to surface waters (Table 4 and Figure 5).

Forester Involvement on individual harvest sites is based primarily on information from the Forest Operations Notification, supplemented by personal or local knowledge of the observers. No distinction is made regarding the level of involvement of foresters in harvest planning, layout, or supervision. Information on certification or training level of involved loggers was not available on most harvest sites and was not included in the monitoring. Therefore, the following information provides only a partial understanding of foresters' influence on BMP use and effectiveness.

Foresters were involved 24% of 288 harvested harvest sites with water bodies (Table 5).

Forester involvement as observed in this study appears not to result in increased rate of application of BMPs or effectiveness in preventing soil movement and delivery to water bodies. Harvest sites with no forester involved were equal to harvest sites with forester involvement with respect to having BMPs used appropriately and ensuring negligible soil movement on site.

Table 5. Forester Involvement				
	Forester involved (68 harvest sites)		No Forester (220 harvest sites)	
	n	%	n	%
BMP Use				
BMPs used appropriately	32	47%	112	51%
Good attempt, needs improvement	18	27%	50	23%
Minimal attempt	11	16%	37	17%
BMPs used after the fact to correct an existing problem	0	0	2	1%
BMPs not applied	7	10%	19	8%
BMP Effectiveness				
Effective - negligible soil movement	43	63%	134	61%
Somewhat effective - soil movement, soil does not reach water body	10	15%	42	19%
Ineffective - minor soil movement, minimal soil delivered to water body	14	21%	40	18%
Ineffective - major soil movement, soil delivered to water body	1	2%	4	2%

Residual shade on water bodies

Harvests on sites with water bodies were predominantly partial harvests (80%). Clearcuts made up 8% of the harvest sites, shelterwood 8%, and overstory removal harvests 2%.

Observers evaluated post-harvest residual shade in riparian zones on 121 harvest sites. On the remaining 167 harvest sites with water bodies, either road issues alone were assessed, or the harvesting was far enough away from the water body in question that the observer determined that shade retention was not an applicable BMP.

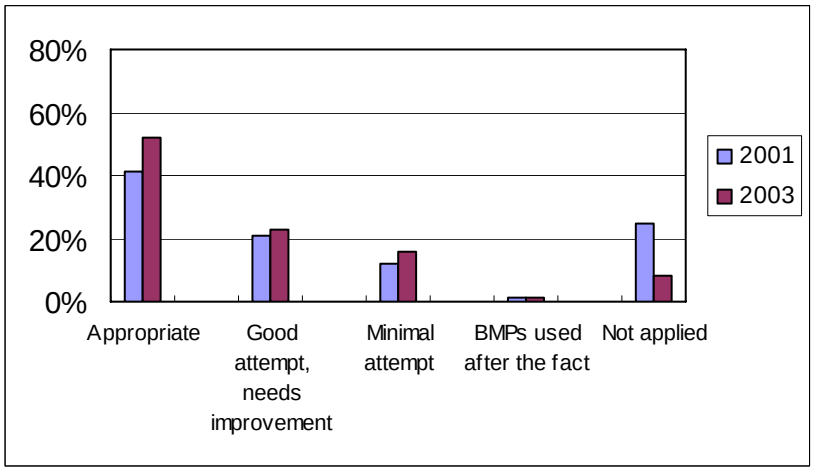
Observers were asked to rate shade reduction due to harvesting in riparian zones, with the following results:

- Harvest with no shade reduction 57%
- Harvest with adequate shade 26%
- Harvest with partial but inadequate shade 9%
- Harvest with no residual shade 8%

Discussion

Results from the 2001 to 2003 field monitoring indicate some improvement in rates of BMP use and effectiveness from those observed in 2000 and the first half of 2001. BMPs were used appropriately or with good attempt in 75% of the latest sample, compared with 62% in 2001 (Figure 6).

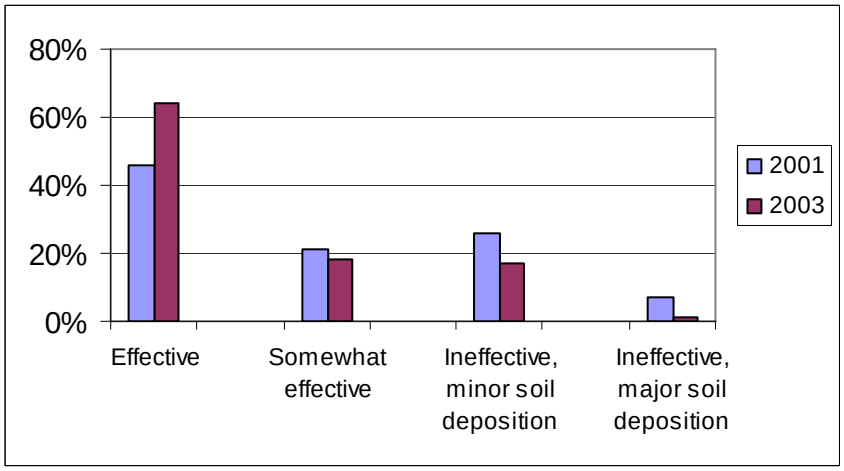
Figure 6. BMP Use



Appropriate BMP use appears to result in reduced likelihood of soil movement and delivery to surface water bodies.

Major discharges of sediment to water bodies are not common (1% of the latest sample), but minor delivery of sediment occurred in nearly 20% of the sample. This is an improvement from 2001, when 7% of the sample showed major sediment delivery and 26% showed minor sediment delivery to surface waters.

Figure 7. BMP Effectiveness



Sediment delivery most often results from failure to use BMPs. First order and second order streams occurred on 32% and 40% of the harvest sites. At the same time, the

presence of water bodies on harvest sites is not as pervasive as might be expected, which may be due in part, to harvest planning to avoid surface waters.

Future Directions for Educational Efforts

MFS has identified three areas to emphasize in future educational efforts:

- target investor ownerships for focused training;
- address issues on temporary stream crossings; and
- address issues on haul roads.

Opportunities to address these areas include training for Certified Logging Professionals and Certified Master Loggers, workshops for members of the Sustainable Forestry Initiative and the Small Woodlot Owners Association of Maine, landowner meetings, and consulting forester training.

Acknowledgements

This report has been made possible through the efforts of the members of FORAT, who have been instrumental in developing and supporting BMP monitoring in Maine. Several FORAT members also contributed considerable additional effort by serving on the quality assurance/quality control team. Maine landowners who participated in monitoring and/or permitted monitoring to go forward on their lands deserve special thanks. Several key MFS staff, including Roger Ryder, Greg Lord, Mort Moesswilde, and Gordon Moore provided invaluable service in developing and providing logistical support for the monitoring.

This report would have been impossible without the hours of dedicated field work by the Foresters and Rangers of the Maine Forest Service.